CLAIMS

1. An edge-connected non-thermal plasma reactor element comprising:

an edge-connected frame comprising a pair of dielectric edge connectors secured at opposite ends to first and second outer dielectric plates to provide said edge-connected frame;

said dielectric edge connectors comprising a backplane and a plurality of tines protruding along at least one major surface of said backplane, said plurality of tines being spaced apart from one another at regular intervals so as to form pockets between adjacent tines; and

a plurality of alternating polarity electrode plates comprising a dielectric barrier plate having an electrode and terminal connection lead disposed on said dielectric barrier plate, said electrode plates disposed within said frame in an arrangement that defines the presence of at least one dielectric barrier next to a plasma cell, said pockets engaging opposite ends of said electrode plates.

2. The element of claim 1, comprising a double dielectric barrier edge-connected element having plasma cells bounded on top and bottom by dielectric.

3. The element of claim 1, comprising a double dieletric barrier edge-connected element having a plurality of mirror image electrode plate pairs disposed in said pockets of said edge-connected frame, said electrode plate pairs arranged so that their electrodes are sandwiched between each electrode plate pair whereby plasma cells formed between adjacent electrode plate pairs are bounded on top and bottom walls by a dielectric barrier.

4. The element of claim 1, comprising a double dieletric barrier edge-connected element having a plurality of mirror image electrode plate pairs disposed in said pockets of said edge-connected frame, said electrode plate pairs arranged so that their electrodes are sandwiched between each electrode plate pair whereby plasma cells formed between adjacent electrode plate pairs are bounded on top and bottom walls by a dielectric barrier; and

top and bottom most pockets have electrode plate-dielectric barrier plate pairs, said electrodes facing away from said plasma cell, disposed therein.

5. The element of claim 1, comprising a double dielectric barrier edge-connected element having a plurality of mirror image electrode plate pairs disposed in said pockets of said edge-connected frame, said electrode plate pairs arranged so that their electrodes are sandwiched between each electrode plate pair whereby plasma cells formed between adjacent electrode plate pairs are bounded on top and bottom walls by a dielectric barrier;

a single electrode plate disposed in a top pocket formed between said first outer dielectric plate and said tines adjacent said first outer dielectric plate;

a single electrode plate disposed in a bottom pocket formed between said second outer dielectric plate and said tines adjacent said second outer dielectric plate;

whereby top and bottom most plasma cells are bounded on top and bottom by a dielectric barrier.

6. The element of claim 1, comprising a double dielectric barrier edge-connected element having a plurality of electrode plates disposed in said pockets of said edge-connected frame, said electrode plates having a dielectric plate-electrode-dielectric plate arrangement, wherein a single electrode is sandwiched between said dielectric plates in sufficiently close contact to both dielectric layers to avoid gaps between said electrode and said dielectric plates that would cause parasitic arcing.

7. The element of claim 1, comprising a single dielectric barrier edge-connected element, having plasma cells bounded on one side by dielectric and on an opposite side by electrode.

8. The element of claim 1, comprising a single dielectric barrier edge-connected element, wherein a single electrode plate is disposed in said pockets of said edge-connected frame to effect an alternating polarity arrangement wherein plasma cells are bounded on one side by dielectric and on an opposite side by an electrode.

9. The element of claim 1, wherein said backplane comprises a gripping surface on a surface opposite said tines.

10. The element of claim 1, wherein said pockets have a first width; and

top and bottom pockets formed by said outer dielectric plates and tines adjacent said outer dielectric plates have a second width that is half that of said first width.

11. The element of claim 1, further comprising an electrode pattern having a small setback wherein said electrode extends to within a short distance from edges of said dielectric plate engaging said tines thereby increasing active electrode area.

12. The element of claim 1, further comprising an electrode pattern having a small setback wherein said electrode extends to within about 5 millimeters from edges of said dielectric plate engaging said tines.

13. The element of claim 1, wherein a distance between a front edge of said dielectric barrier electrode plate to a proximate edge of said electrode is large relative to the thickness of said tines.

14. The element of claim 1, wherein said dielectric edge connectors comprise a low dielectric constant material or a high dielectric constant material in combination with a low dielectric constant constituent.

15. The element of claim 1, wherein said edge connectors comprise linking edge connectors having a central backplane and a plurality of tines protruding along two opposite major surfaces of said backplane, said plurality of tines being spaced apart from one another at regular intervals so as to form pockets between adjacent tines.

16. The element of claim 1, wherein said edge-connected frame comprises an integral frame.

17. The element of claim 1, wherein said edge-connected frame comprises discrete edge connector and outer dielectric plate sections joined together to form said edge-connected frame.

18. A non-thermal plasma reactor having an edge-connected element comprising:

an edge-connected frame comprising a pair of dielectric edge connectors secured at opposite ends to first and second outer dielectric plates to provide said edge-connected frame;

said dielectric edge connectors comprising a backplane and a plurality of tines protruding along at least one major surface of said backplane, said plurality of tines being spaced apart from one another at regular intervals so as to form pockets between adjacent tines; and

a plurality of alternating polarity electrode plates comprising a dielectric barrier plate having an electrode and terminal connection lead disposed on said dielectric barrier plate, said electrode plates disposed within said frame in an arrangement that defines the presence of at least one dielectric barrier next to a plasma cell, said pockets engaging opposite ends of said electrode plates;

a high temperature housing surrounding said edge-connected element and spaced therefrom by a retention mat supporting said edge-connected element in said housing;

an inlet for admitting a stream to be treated into said plasma cells;

an outlet for discharging a treated fluid stream from said plasma cells;

a power bus path for connecting power electrode plates to a high voltage source;

a ground bus path for connecting the ground electrodes to ground; and

means for directing said fluid stream through said plasma cells.

19. The reactor of claim 18, wherein electrode plates are rigidly connected to said edge-connected frame at front or rear of said reactor element and are otherwise compliantly supported by said pockets thereby providing electrode plates that are free to expand within the edge-connected frame in response to thermally induced stress.

20. The reactor of claim 19, further comprising a dielectric, high temperature adhesive disposed at either front or rear of said element to fasten said electrode plates to said edge connected frame, said adhesive being disposed over and around said bus paths to fix and protect said bus paths and secure the element assembly together.

21. The reactor of claim 18, wherein said mat comprises a dielectric retention mat providing a compliant pressure against exterior portions of said reactor element adjacent said housing and front and rear end portions of said reactor element, thereby providing compliant fixturing for said electrode plates packaged in said housing.

22. The reactor of claim 18, comprising a double dielectric barrier edge-connected element having plasma cells bounded on top and bottom by dielectric.

23. The reactor of claim 18, comprising a double dielectric barrier edge-connected element having a plurality of mirror image electrode

plate pairs disposed in said pockets of said edge-connected frame, said electrode plate pairs arranged so that their electrodes are sandwiched between each electrode plate pair whereby plasma cells formed between adjacent electrode plate pairs are bounded on top and bottom walls by a dielectric barrier.

24. The reactor of claim 18, comprising a double dielectric barrier edge-connected element having a plurality of mirror image electrode plate pairs disposed in said pockets of said edge-connected frame, said electrode plate pairs arranged so that their electrodes are sandwiched between each electrode plate pair whereby plasma cells formed between adjacent electrode plate pairs are bounded on top and bottom walls by a dielectric barrier; and

top and bottom most pockets have electrode plate-dielectric barrier plate pairs, said electrodes facing away from said plasma cell, disposed therein.

25. The reactor of claim 18, comprising a double dielectric barrier edge-connected element having a plurality of mirror image electrode plate pairs disposed in said pockets of said edge-connected frame, said electrode plate pairs arranged so that their electrodes are sandwiched between each electrode plate pair whereby plasma cells formed between adjacent electrode plate pairs are bounded on top and bottom walls by a dielectric barrier;

a single electrode plate disposed in a top pocket formed between said first outer dielectric plate and said tines adjacent said first outer dielectric plate;

a single electrode plate disposed in a bottom pocket formed between said second outer dielectric plate and said tines adjacent said second outer dielectric plate;

whereby top and bottom most plasma cells are bounded on top and bottom by a dielectric barrier.

26. The reactor of claim 18, comprising a double dielectric barrier edge-connected element having a plurality of electrode plates disposed in said pockets of said edge-connected frame, said electrode plates having a dielectric plate-electrode-dielectric plate arrangement, wherein a single electrode is sandwiched between said dielectric plates in sufficiently close contact to both dielectric layers to avoid gaps between said electrode and said dielectric plates that would cause parasitic arcing.

27. The reactor of claim 18, comprising a single dielectric barrier edge-connected element, having plasma cells bounded on one side by dielectric and on an opposite side by electrode.

28. The reactor of claim 18, comprising a single dielectric barrier edged-connected element, wherein a single electrode plate is disposed in said pockets of said edge-connected frame to effect an alternating polarity arrangement wherein plasma cells are bounded on one side by dielectric and on an opposite side by an electrode.

29. The reactor of claim 18, wherein said backplane comprises a gripping surface on a surface opposite said tines.

30. The reactor of claim 18, wherein a majority of said pockets have a first width; and

top and bottom pockets formed by said outer dielectric plates and tines adjacent said outer dielectric plates have a second width that is half that of said first width.

31. The reactor of claim 18, further comprising an electrode pattern having a small setback wherein said electrode extends to within a short distance from edges of said dielectric plate engaging said tines thereby increasing active electrode area.

32. The reactor of claim 18, further comprising an electrode pattern having a small setback wherein said electrode extends to within about 5 millimeters from edges of said dielectric plate engaging said tines.

33. The reactor of claim 18, wherein a distance between a front edge of said dielectric barrier electrode plate to a proximate edge of said electrode is large relative to the thickness of said tines.

34. The reactor of claim 18, wherein said dielectric edge connectors comprise a low dielectric constant material or a high dielectric constant material in combination with a low dielectric constant constituent.

35. The reactor of claim 18, wherein said edge connectors comprise linking edge connectors having a central backplane and a plurality of tines protruding along two opposite major surfaces of said backplane, said

plurality of tines being spaced apart from one another at regular intervals so as to form pockets between adjacent tines.

36. The reactor of claim 18, wherein said backplane is continuous over opposite sides of said edge-connected non-thermal plasma reactor element when assembled thereby preventing charge leakage.

37. The reactor of claim 18, wherein said gripping surface of said backplane further serves to create a tortuous path between said backplane and said mat material thereby reducing the potential for untreated gas to leak between said backplane and said mat.

38. The reactor of claim 18, wherein said edge-connected frame comprises an integral frame.

39. The reactor of claim 18, wherein said edge-connected frame comprises discrete edge connector and outer dielectric plate sections joined together to form said edge-connected frame.